

PATENT



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Hsu et al.

Serial No.: 10/772,824

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For: Laundry Detergent Gel With Suspended Particles

Group: 1751  
Examiner: N. Ogden  
Edgewater, New Jersey 07020  
February 25, 2005

DECLARATION UNDER 37 C.F.R 1.132

Commissioner of Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

I, Yun-Peng Zhu of 7-17 Oak Street, Fairlawn, New Jersey 07410 hereby declare as follows:

1. My educational background is as follows:  
B.S. in Chemical Engineering in 1983.  
Ph.D in Chemistry in 1993.
2. I joined Unilever Home and Personal Care; U.S.A. in 2001 and since then held the position of Senior Project Scientist.
3. I am familiar with the subject matter of the above identified patent application of which I am a named co-inventor and I am also familiar with WO 99/06519 (WO '519) and GB 2 355 015 (GB '015).
4. The following calculations of non-neutralized fatty acid content in the Examples of the patent WO '519 and GB '015 (the examples being identical on both) were performed by me.

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The pKa values of the acids that were used were as follows (references attached):

Compounds	pKa	Reference
Citric acid	pKa1=3.14 pKa2=4.77 pKa3=6.39	CRC-Chemistry Handbook 80th edition page 8-51
Boric acid	pKa1=9.27 pKa2 > 14	page 8-44
Fatty acid Chain length		J. R. Kanicky et al., Langmuir, 16, 172-177 (2000)
8	6.3~6.5	page 177
10	7.1~7.3	page 177
12	~7.5	page 177
14	8.1~8.2	page 177
16	8.6~8.8	page 177

Boric acid (present in Examples A and B of WO '0519 and GB '015 has higher pKa values than fatty acids. Therefore, fatty acids and citric acid are first neutralized by the base, and then boric acid is neutralized by the remaining base if any is left.

The molecular weights of several alkalines were not disclosed, therefore, they were not used in the calculation of neutralization. If these alkalines were used in the calculation, then the degree of neutralization or over-neutralization would have been even much higher.

The ingredients in the Examples were separated into acid and base ingredients, and converted to mmol amounts, as indicated in Table 2 below. The results that were obtained are summarized in Table 1.

TABLE 1

RESULTS

Examples from US6506716B1	Free Fatty Acid		Free Boric Acid	
	wt%	mmol	wt%	mmol
A	0	0	1.3	21.1
B	0	0	1.9	31.5
C	0	0	0	0
D	0	0	0	0
E	0	0	0	0
F	0	0	0	0
G	0	0	0	0
H	0	0	0	0
I	0	0	0	0
J	0	0	0	0
K	0	0	0	0
L	0	0	0	0
M	0	0	0	0

TABLE 2

		A g/mol	wt%	mmol	B Wt%	mmol	C Wt%	mmol	D Wt%	mmol	E Wt%	mmol	F wt% mmol
Ingredients													
Base													
C8-10amidopropylamine	242	1.3	5.4	1.3	5.4								
C10amidopropylamine	256			0.00	1.3	5.08	1.3	5.08	1.3	5.08	1.3	5.08	
polymer A	842	0.66	3.9	0.66	3.9	0.6	3.56	0.6	3.56	0.6	3.56	0.6	3.56
polymer B	1380			0.00	1.2	unknown	1.2	unknown	1.2	unknown	1.2	unknown	1.2
polyamine-polyamide	unknown	2	unknown	unknown	1								
polyethoxylated polyamines	unknown			1	unknown	2	unknown	unknown	unknown	unknown	1	unknown	1
MEA	61	0.7	11.5	0.7	11.5	0.5	8.20	0.5	8.20	0.5	8.20	0.5	8.20
NaOH	40	2.8	70.0	2.8	70.00	7	175.00	7	175.00	7	175.00	7	175.00
Total base				90.8		90.8		191.84		191.84		191.84	
Acid													
Citric acid	192.12	1	15.6	3	46.8	5	78.08	1	15.62	2.5	39.04	1	15.62
C12/C14 acid	214		0.0		0.0	10	46.73	10	46.73	8.0	37.38	10	46.73
palm kernel fatty acid	225.34	8	35.5	5.4	24.0								
Rapeseed fatty acid	281.25	8	28.4	5.4	19.2								
Total acid without boric acid			79.6		90.0		124.81		62.34		76.42		62.34
Boric acid	61.83	2	32.3	2	32.3	0	0	0	0	0	0	0	0

TABLE 2 cont'd

		G	H	I	J	K	L	M					
	g/mol	wt%	mmol										
Examples from US6506716B1													
Ingredients													
Base													
C8-10 amidopropylamine	242												
C10amidopropylamine	256	1.3	5.1	1.3	5.08	1.3	5.08	1.3	5.08	1.3	5.08	1.3	5.08
polymer A	842	0.6	3.9	0.6	3.92	0.3	3.56	0.6	3.56	0.6	3.56	0.6	3.56
polymer B	1380	1.2	unknown										
polyamine-polyamide	unknown	1	unknown	1	unknown								
Polyethoxylated polyamines	unknown												
MEA	61	0.48	7.9	0.48	7.9	0.48	7.87	0.48	7.87	0.48	7.87	0.48	7.87
NaOH	40	7.0	175.0	7	175.0	7	175.00	7	175.00	7	175.00	7	175.00
Total base			191.56		191.56		189.7		191.51		191.51		191.51
Acid													
Citric acid	192.12	1	15.6	1	15.6	1	15.62	1	15.62	1	15.62	1	15.62
C12/C14 acid	214	10.0	46.7	10	46.7	10	46.73	10	46.73	7.5	35.05	5	23.36
palm kernel fatty acid	225.34	0	0.0	0	0.0	0	0.00	0	0.00				10
Rapeseed fatty acid	281.25	0	0.0	0	0.0	0	2.5	8.87					46.73
Oleic acid	282												
Total acid without boric acid			62.3		62.3		62.34		62.34		50.66		38.98
Boric acid	61.83	0	0	0	0	0	0	0	0	0	0	0	0

5. I conclude from the calculation results in Table 1 that that fatty acid included in the WO '519 and GB '015 examples was all neutralized, so that no free fatty acid was present. This result is in agreement with the teaching of WO '519 to use fatty acid as a surfactant, i.e. to use fatty acid in neutralized form and the teaching of GB '015 to use soaps (again, neutralized form of fatty acid).

6. Examples A and B (both outside the scope of the invention) were prepared by following procedure described in Examples 1-2 of the specification. The results that were obtained are summarized in Table 3.

TABLE 3

Ingredients	% by weight of the composition Example No.	
	A	B
Linear alkyl Benzene Sulphonic Acid	3.82	3.82
Non-ionic (C12-C14, 9 EO)	4	4
Oleic Acid	4	4
Coconut Fatty Acid	8	4
Sorbitol (70% active)	7.9	7.9
Borax	2.3	2.3
NaOH (50 % active)	1	1.02
Monoethanolamine	0.3	1.04
Propylene Glycol		2
Water and Miscellaneous	To 100	To 100
Degree of FA Neutralization, %	10	100
pH	5.9	9.0
% Surfactant;	9.61	18.17
% Fatty Acid		
Added	12	8
Non-neutralized	10.80	0.00
Weight % ratio non-neutralized Fatty Acid to surfactant	1.12	0.00

In Example A the weight % ratio of total non-neutralized fatty acid to total surfactant was more than 1-- Example A was phase separated in 24 hours. The fatty acids in Example B were fully neutralized which resulted in the sample which was an isotropic liquid.

I conclude that the presence of non-neutralized fatty acid is critical for the formation of the gel.

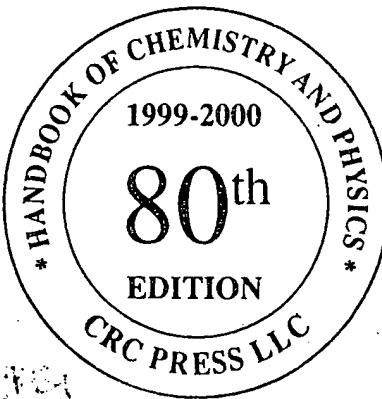
7. All statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

1/14/2005  
Date

Yun-Peng Zhu  
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**DISSOCIATION CONSTANTS OF ORGANIC ACIDS AND BASES (continued)**

Molecular formula	Name	Step	T°C	pK <sub>a</sub>
C <sub>6</sub> H <sub>5</sub> N	-3-Methylpyridine		20	5.68
C <sub>6</sub> H <sub>5</sub> N	4-Methylpyridine		20	6.02
C <sub>6</sub> H <sub>5</sub> NO	Methoxypyridine		25	6.47
C <sub>6</sub> H <sub>5</sub> NO <sub>3</sub> S	<i>o</i> -Aminobenzenesulfonic acid		25	2.48
C <sub>6</sub> H <sub>5</sub> NO <sub>3</sub> S	<i>m</i> -Aminobenzenesulfonic acid		25	3.73
C <sub>6</sub> H <sub>5</sub> NO <sub>3</sub> S	<i>p</i> -Aminobenzenesulfonic acid		25	3.24
C <sub>6</sub> H <sub>5</sub> N <sub>2</sub>	<i>N</i> -Methylpyridinamine		20	9.65
C <sub>6</sub> H <sub>5</sub> O <sub>6</sub>	Ascorbic acid		24	4.10
C <sub>6</sub> H <sub>6</sub> O <sub>7</sub>	<u>Citric acid</u>	1	16	11.79
		2	20	3.14
C <sub>6</sub> H <sub>8</sub> O <sub>7</sub>	Isocitric acid	3	20	4.77
		1	20	<u>6.39</u>
C <sub>6</sub> H <sub>9</sub> NO <sub>6</sub>	$\gamma$ -Carboxyglutamic acid	3	25	3.29
		1	25	4.71
		2	25	6.40
		3	25	1.7
C <sub>6</sub> H <sub>9</sub> N <sub>3</sub>			25	3.2
C <sub>6</sub> H <sub>9</sub> N <sub>3</sub> O <sub>2</sub>	4,6-Dimethylpyrimidinamine	4	25	4.75
	Histidine		20	9.9
		1	25	4.82
		2	25	1.80
C <sub>6</sub> H <sub>10</sub> O <sub>3</sub>	2-Oxo-3-methylpentanoic acid	3	25	6.04
C <sub>6</sub> H <sub>10</sub> O <sub>4</sub>	Adipic acid		25	9.33
C <sub>6</sub> H <sub>10</sub> O <sub>4</sub>		1	25	2.3
C <sub>6</sub> H <sub>11</sub> NO <sub>2</sub>	3-Methylglutaric acid	2	25	4.43
	<i>L</i> -Pipercolic acid		25	5.41
C <sub>6</sub> H <sub>11</sub> NO <sub>3</sub>		1	25	4.24
C <sub>6</sub> H <sub>11</sub> NO <sub>4</sub>	Adipamic acid	2	25	2.28
	2-Amino adipic acid		25	<u>10.72</u>
		1	25	4.63
		2	25	2.14
C <sub>6</sub> H <sub>11</sub> N <sub>3</sub> O <sub>4</sub>	Glycylasparagine	3	25	4.21
C <sub>6</sub> H <sub>11</sub> N <sub>3</sub> O <sub>4</sub>		1	25	9.77
		2	18	2.942
C <sub>6</sub> H <sub>12</sub> N <sub>2</sub> O <sub>4</sub> S <sub>2</sub>	Cystine	1	25	8.44
		2	25	3.225
		1	35	8.09
C <sub>6</sub> H <sub>12</sub> O <sub>2</sub>	Hexanoic acid	2	35	2.1
C <sub>6</sub> H <sub>12</sub> O <sub>2</sub>	4-Methylpentanoic acid		35	8.0
C <sub>6</sub> H <sub>13</sub> N	Cyclohexylamine		25	4.85
C <sub>6</sub> H <sub>13</sub> N	1,2-Dimethylpyrrolidine		18	4.84
C <sub>6</sub> H <sub>13</sub> NO <sub>2</sub>	1-Methylpiperidine		24	10.66
C <sub>6</sub> H <sub>13</sub> NO <sub>2</sub>	6-Aminohexanoic acid		26	10.20
C <sub>6</sub> H <sub>13</sub> NO <sub>2</sub>			25	10.08
	Isoleucine	1	25	4.373
		2	25	<u>10.804</u>
C <sub>6</sub> H <sub>13</sub> NO <sub>2</sub>	<i>L</i> -Leucine	1	25	2.32
C <sub>6</sub> H <sub>13</sub> NO <sub>2</sub>		2	25	9.76
H <sub>13</sub> N <sub>3</sub> O <sub>3</sub>	Norleucine	1	25	2.328
H <sub>13</sub> N <sub>3</sub> O <sub>3</sub>		2	25	9.744
C <sub>6</sub> H <sub>14</sub> N <sub>2</sub>	Citrulline	2	25	2.335
C <sub>6</sub> H <sub>14</sub> N <sub>2</sub>		1	25	9.83
C <sub>6</sub> H <sub>14</sub> N <sub>2</sub>	<i>cis</i> -1,2-Cyclohexanediamine	2	25	2.43
C <sub>6</sub> H <sub>14</sub> N <sub>2</sub>		1	20	9.69
C <sub>6</sub> H <sub>14</sub> N <sub>2</sub>	<i>trans</i> -1,2-Cyclohexanediamine	2	20	9.93
C <sub>6</sub> H <sub>14</sub> N <sub>2</sub>		1	20	6.13
C <sub>6</sub> H <sub>14</sub> N <sub>2</sub>	2,5-Dimethylpiperazine	2	20	9.94
		1	25	6.47
		2	25	9.66
			25	5.20

## DISSOCIATION CONSTANTS OF INORGANIC ACIDS AND BASES

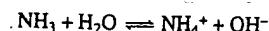
The data in this table are presented as values of  $pK_a$ , defined as the negative logarithm of the acid dissociation constant  $K_a$



Thus  $pK_a = -\log K_a$ , and the hydrogen ion concentration  $[H^+]$  can be calculated from

$$K_a = \frac{[H^+][B^-]}{[BH]}$$

In the case of bases, the entry in the table is for the conjugate acid; e.g., ammonium ion for ammonia. The  $OH^-$  concentration is



can be calculated from the equation

$$K_b = K_{water} / K_a = \frac{[OH^-][NH_4^+]}{[NH_3]}$$

where  $K_{water} = 1.01 \times 10^{-14}$  at 25 °C. Note that  $pK_a + pK_b = pK_{water}$ .

All values refer to dilute aqueous solutions at zero ionic strength at the temperature indicated. The table is arranged alphabetically by name.

### REFERENCE

1. Perrin, D. D., *Ionization Constants of Inorganic Acids and Bases in Aqueous Solution, Second Edition*, Pergamon, Oxford.

Name	Formula	Step	$t/^\circ C$	$pK_a$
Aluminum(III) ion	$Al^{+3}$		25	5.0
Ammonia	$NH_3$		25	9.25
Arsenic acid	$H_3AsO_4$	1	25	2.26
		2	25	6.76
		3	25	11.29
Arsenious acid	$H_2AsO_3$		25	9.29
Barium(II) ion	$Ba^{+2}$		25	13.4
Boric acid	$H_3BO_3$	1	20	9.27
		2	20	>14
Calcium(II) ion	$Ca^{+2}$		25	12.6
Carbonic acid	$H_2CO_3$	1	25	6.35
		2	25	10.33
Chlorous acid	$HClO_2$		25	1.94
Chromic acid	$H_2CrO_4$	1	25	0.74
		2	25	6.49
Cyanic acid	$HCNO$		25	3.46
Germanic acid	$H_2GeO_3$	1	25	9.01
		2	25	12.3
Hydrazine	$N_2H_4$		25	8.1
Hydrazoic acid	$HN_3$		25	4.6
Hydrocyanic acid	$HCN$		25	9.21
Hydrofluoric acid	$HF$		25	3.20
Hydrogen peroxide	$H_2O_2$		25	11.62
Hydrogen selenide	$H_2Se$	1	25	3.89
		2	25	11.0
Hydrogen sulfide	$H_2S$	1	25	7.05
		2	25	19
Hydrogen telluride	$H_2Te$	1	18	2.6
		2	25	11
Hydroxylamine	$NH_2OH$		25	5.94
Hypobromous acid	$HBrO$		25	8.55

# Cooperativity among Molecules at Interfaces in Relation to Various Technological Processes: Effect of Chain Length on the $pK_a$ of Fatty Acid Salt Solutions<sup>†</sup>

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The orientation of surface-active molecules at interfaces is extremely important in determining the dynamic and equilibrium properties of such systems. Films of fatty acid salts were studied at various pH values of the solutions. It was found that there exists a pH where minimum evaporation of water, maximum foamability, maximum foam stability, minimum contact angle on PMMA surface, maximum single-bubble stability, and maximum surface viscosity are observed. It was also found that this optimum pH value is near the  $pK_a$  of the fatty acid salts. The experimental results are explained in terms of area per molecule, intermolecular spacing, and cooperativity among soap molecules at the interface. It was further shown that the chain length of the soap molecules can modulate the area per molecule, and hence the intermolecular distance in the film, and thereby influence the ionization behavior of the fatty acid carboxyl group. The  $pK_a$  increases from 6.5 to about 9.0 as the chain length of the fatty acid salt increases from  $C_8$  to  $C_{16}$ . Cooperativity among surfactant molecules at the interface is controlled by the area per molecule and intermolecular spacing in the adsorbed film. A small change in intermolecular distance of 0.03 Å can significantly influence various technological processes such as foaming, emulsification, wetting, and retardation of evaporation.

## Introduction

The manner in which surfactant molecules align at an interface is an important factor in systems involving interfacial films. Among the important properties of a surfactant that dictate the strength, elasticity, and stability of a surface film are chain length compatibility,<sup>1</sup> the distance between molecules in the monolayer,<sup>2</sup> and surface activity. The presence of a net charge on a surfactant polar group affects its surface activity. Fatty acids, for instance, can become ionized by an increase in the pH of the solution. If all the fatty acid molecules become ionized, repulsion between similarly charged molecules in the monolayer can result in an expansion of the monolayer at high pH,<sup>3,4</sup> which in turn can lead to a weak and unstable film. The change in monolayer characteristics of fatty acids as a function of pH of the bulk solution was first reported by Schulman and Hughes,<sup>5</sup> who found that the surface potential ( $\Delta V$ )–pH relation resembled an acid–base titration curve. For weakly ionized monolayers such as those created by fatty acids, it was proposed that the difference in  $pK_a$  between the surface and the bulk is small.<sup>6</sup> This suggests that one may calculate surface properties, including surface pH, using the normal bulk

value of the  $pK_a$ . However, the present paper reports that the  $pK_a$  of soap depends on the chain length of the soap molecule and can be as high as about 9.0 as the chain length increases to  $C_{16}$ .

Most short-chain carboxylic acids have a  $pK_a$  value of ca. 4.8. For example, when acetic acid ( $CH_3COOH$ ) and propionic acid ( $CH_3CH_2COOH$ ) are dissolved in water, their  $pK_a$  values are found to be 4.74 and 4.87, respectively.<sup>7</sup> The  $pK_a$  value represents the ionic environment of the solution where 50% of the hydrogen atoms are removed from the carboxyl group by the existing  $OH^-$  ions in the solution. The  $pK_a$  can be decreased by attaching an electron-accepting substituent to stabilize the carboxylate anion.<sup>8</sup> The converse effect—that of electron-releasing substituents lowering the acidity and raising the  $pK_a$ —is true, though less dramatic. The  $pK_a$  can be raised by increasing the carbon chain length of the carboxylic acid. However, because electronic effects are not felt beyond two to three carbons, when the chain length is increased beyond about four carbons, the  $pK_a$  tends to level off. Increasing the chain length from pentanoic to hexanoic acid, for example, increases the  $pK_a$  from 4.82 to 4.83. Therefore, we know that *intra*molecular interactions (i.e., the effects on the carboxylate anion by the rest of the carbon chain) become negligible beyond four carbons in the alkyl chain. We believe that van der Waals and polar group interactions between fatty acid molecules raise the  $pK_a$  from 4.83 for hexanoic acid to approximately 7.5 for lauric acid, and even higher  $pK_a$  values for longer-chain carboxylic acids.

The present paper attempts to explain various  $pK_a$ -related phenomena and elucidate their technological applications (e.g., foaming, foam stability, retardation

\* To whom correspondence should be addressed. E-mail: shah@che.ufl.edu.

<sup>†</sup> Part of the Special Issue "Clifford A. Bunton: From Reaction Mechanisms to Association Colloids: Crucial Contributions to Physical Organic Chemistry".

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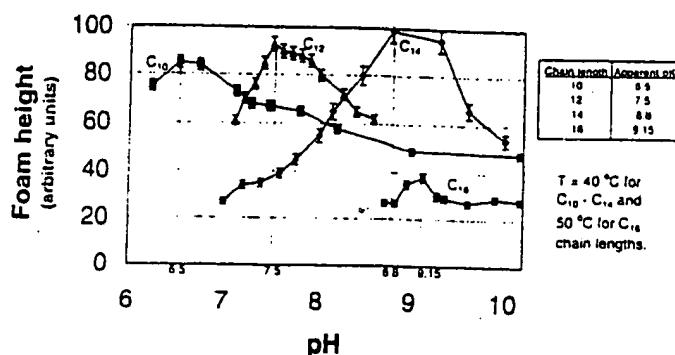


Figure 8. An increase in soap chain length leads to a shift in apparent  $pK_a$ , as reflected by foamability during the shaking method.

Table 2. Comparison between Experimentally Determined  $pK_a$  Values and Observed Phenomena for Fatty Acid Salts of (C<sub>8</sub>-C<sub>16</sub>) Chain Lengths

soap chain length	measd $pK_a$	pH of max foam height	pH of min evap rate	pH of min contact angle
8	6.3-6.5	a	6.9	7.0
10	7.1-7.3	6.5	7.1	7.2
12	~7.5	7.5	7.5	7.5
14	8.1-8.2	8.8	8.1-8.3	7.6
16	8.6-8.8	9.15	8.9-9.0	b

<sup>a</sup> Negligible foam generated. <sup>b</sup> Insoluble at room temperature.

between experimentally determined  $pK_a$  values and observed phenomena near  $pK_a$  for fatty acid salts of (C<sub>8</sub>-C<sub>16</sub>) chain lengths. As can be seen in this table, pH values corresponding to minima in contact angle on PMMA and evaporation rate are similar to experimentally determined  $pK_a$  values. Again, the shift in  $pK_a$  due to increase in chain length seems directly related to increased van der Waals interaction between soap molecules. Thus, the above results indicate that *cooperativity* among molecules at interfaces induced by the van der Waals interactions between chains and the concomitant polar group interactions cause reduced intermolecular distance leading to optimum behavior of various properties exhibited by the soap solution near its  $pK_a$  value.

Figure 9 schematically illustrates the proposed mechanism for the effect of increasing chain length on intermolecular distance of fatty acids at their respective  $pK_a$  values. It was shown previously by Shiao et al. (1997) that changes in intermolecular distance as small as 0.04 Å induced by mixing surfactants of different chain lengths can significantly influence performance of various technological processes such as foaming, emulsification, lubrication, wetting, and retardation of evaporation by films. We have shown further (Table 1) in the present paper that similar subangstrom changes (0.03 Å) in intermolecular distance can be produced by ionization of

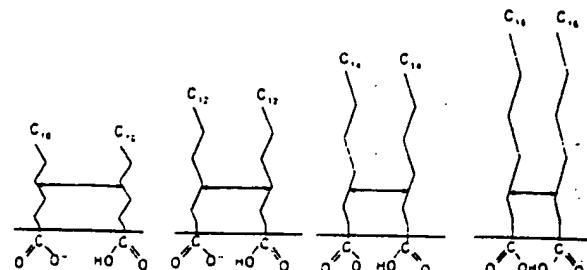


Figure 9. Schematic illustration of the proposed mechanism for the effect of chain length on the intermolecular distance between molecules in the adsorbed film at their respective  $pK_a$  values.

the polar headgroups near their respective  $pK_a$  values, and this in turn will cause striking changes in the performance of various technological processes.

### Conclusions

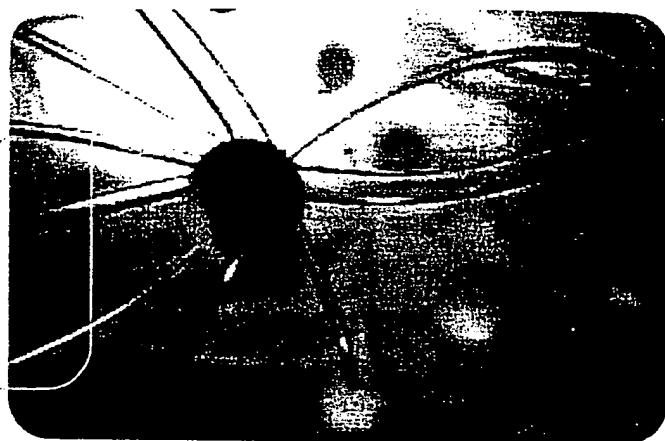
It has been shown that soap exhibits optimum properties at a pH near its  $pK_a$  in various technological processes. Specifically, foam height, foam stability, and bubble lifetime show maximum values, and contact angle on PMMA and water evaporation rate show minimum values at the bulk  $pK_a$  of sodium laurate. Further studies indicate that an increase in the chain length of the soap molecule results in a shift in  $pK_a$  toward a greater value due to molecular cooperativity induced by van der Waals interactions between hydrophobic chains and greater interactions among polar groups.

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LA990719O

**Prifac™**  
Distilled fatty acids

**uniQema**



**Tallow based fatty acids**

Trade name	Description (INCI name: Tallow acid) CAS number: 67701-06-8	Specifications					Typical composition %							
		Titre °C	Iodine gl/100g	Acid mgKOH/g	Saponification mgKOH/g	Color, Lov. 5 1/4* Cell (maximum)	Unsap (maximum)	C14	C16	C16:1	C18	C18:1	C18:2	C18:3
Prifac 7943	Tallow fatty acid	40 - 45	40 - 57	200 - 208	200 - 210	15.0Y - 2.0R	0.2	2	25	4	20	43	5	1
Prifac 7920	Tallow fatty acid	38 - 45	40 - 62	200 - 208	200 - 210	40.0Y - 6.5R	0.2	2	25	5	17	40	9	2

**Coconut and palm kernel fatty acids**

Trade name	Description (INCI Name) CAS Number	Specifications					Typical composition %							
		Titre °C	Iodine gl/100g	Acid mgKOH/g	Saponification mgKOH/g	Color, Lov. 5 1/4* Cell (maximum)	C8	C10	C12	C14	C16	C18	C18:1	C18:2
Prifac 7901	Distilled coconut fatty acid (Coconut acid) 67701-05-7	22-26	6-11	264-274	265-275	10.0Y-1.5R	7	6	49	18	10	8	1	1
Prifac 7902	Stripped coconut fatty acid (Coconut acid) 67701-05-7	23.0-30.0	14.0 max.	254-273	256-275	15.0Y-2.0R	1	55	22	11	3	4	1	1
Prifac 5916	Hydrogenated coconut fatty acid (Hydrogenated coconut acid) 67701-05-7	24-28	5.0 max.	268-276	270-278	3.0Y-0.5R	7	6	49	18	10	8	1	1
Prifac 7908	Palm kernel fatty acid (Palm kernel acid) 67701-05-7	25-30	16-21	244-254	245-255	3.0Y-0.5R	1.1	50	17	9.5	2.6	17	2.6	1

**Vegetable based fatty acids**

Trade name	Description CAS Number	Specifications					Typical composition %									
		Titre °C	Iodine gl/100g	Acid mgKOH/g	Saponification mgKOH/g	Color, Lov. 5 1/4* Cell (maximum)	C12	C14	C16	C18	C18:1	C18:2	C18:3	>C18:1	C20	C22+C22
Prifac 8944	Rapeseed fatty acid 68002-85-7	14 max.	115-123	197-200	198-201	15.0Y-1.5R	4.8	1.8	62	20	8.5	3	0.3	1	1	1
Prifac 8951	Soya fatty acid 67701-08-0	21-27	123-130	194-204	195-205	2.5Y-0.5R	26	47	7						20	1
Prifac 8954	Soya fatty acid 67701-08-0	22-26	125-135	194-204	195-205	10.0Y-1.0R	23	50	5						18	1
Prifac 7990*	Modified, branched fatty acid 68955-98-6	28-35	40-55	185-195	195-205	0.8Y-0.2R <sup>4</sup>	1	1	17	56	4	9	11			

Cloud point, °C

Lovibond - 1" Cell

Composition: Fatty acids - Branched fatty acids

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